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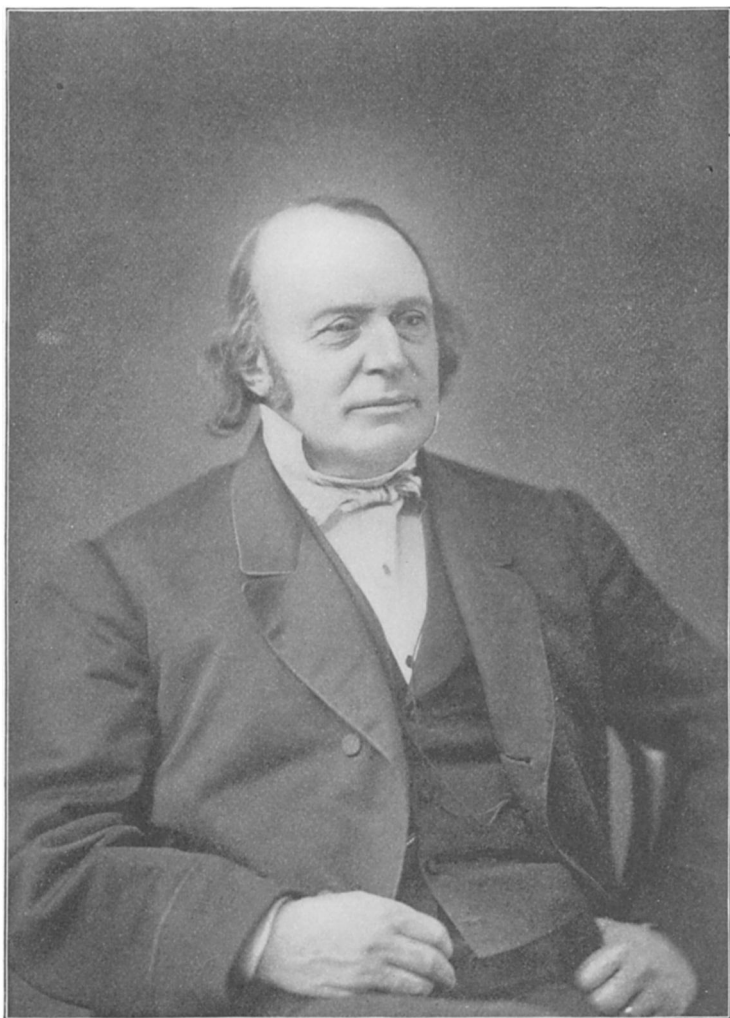
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LOUIS AGASSIZ.

From a photograph kindly lent by Professor Burt G. Wilder.

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LOUIS AGASSIZ.

Two extensive accounts of the life of Louis Agassiz have already been written, one from the hands of Mrs. Agassiz, the revered president of Radcliffe College, the other by his life-long friend Jules Marcou. We have no intention of preparing a third, nor do we expect to throw new light upon the subject. We only offer an outline of his life merely as an introduction to the following articles, which deal with some of the special studies of the great naturalist.

Louis Jean Rudolf Agassiz, descendant from a long line of ministers, was born at the little village of Motier, Switzerland, between the lakes of Neuchâtel and Morat, May 28, 1807. In his early years he showed great fondness for the water and for the animals to be found in it, as well as for athletic sports; and when the time came for him to make the decision as to his life work, he turned aside from the ministry and from a business career and went to Zürich to study medicine. The school at Zürich at that time was nothing like that of to-day, for then the present university was not founded. So from Zürich he turned to Heidelberg, where he made acquaintances and friends,—the Schimpers and Brauns, who were to play no small part in his future development, some of these friendships persisting throughout his life. Here at Heidelberg he obtained

his first introduction into zoology and paleontology, fields which he was later to make peculiarly his own. For still greater facilities he and his friends soon turned to the newly established University of Munich, where in 1830 he received the degree of Doctor of Medicine.

During these undergraduate days he paid more attention to zoology than to the strictly medical studies, and his room became a great resort for others having similar tastes. Here each member had his special subject and delivered lectures upon it to the others, so that the term, "the little academy," applied to these meetings contained as much truth as jest. The life which Agassiz lived here has a lesson for our students. Making due allowance for the differences in prices, the money which his father and friends could give him for his education would fall far below that spent by our students to-day, and yet out of this pittance Agassiz not only supported himself and aided friends, but he employed an artist to draw the fishes for proposed works,—the fishes of central Europe and those collected by Martius and Spix in Brazil.

Here, too, he began his investigations upon the fossil fishes, and soon, by borrowing, he had at his command an enormous collection of these forms. The task was enough to appall most persons. The fossils were in all conditions of preservation, and in those days little was known of the osteology of the recent forms. Yet order was brought out of chaos, and these early studies were the foundation of all subsequent work in this line. It matters little if we can no longer use the scales as a character for the separation of the major groups of the fish-like forms; the *Researches on Fossil Fishes* shows great anatomical insight and powers of generalization.

These studies of fishes led him to Paris, then the great centre of all scientific work, and here he formed the acquaintance of Cuvier and Humboldt, and Cuvier opened the collections of fossil fishes in the museum to the young student. While in Paris he received the appointment as Professor of Natural Science at the Academy of Neuchâtel. When he began his labors there he was without facilities for his work; collections and apparatus, aside from his own private property, were lack-

ing; even rooms for his classes were with difficulty obtained. Yet he soon built up a most flourishing school of natural history. Out of his limited salary he supported collectors, assistants, artists, and secretaries. He went farther and became his own publisher and started a large lithographic establishment, the chief business of which was to furnish illustrations, in a style until then never seen, for the rapidly increasing series of works turned out from the busy hive.

The school at Neuchâtel was not a university, but Agassiz made it one of the scientific centres of the world. To it came visitors and students from all parts of Europe. That its prominence at this time was due solely to Agassiz is shown by the fact that when he left for the United States the academy at once sank back to its former inconspicuous condition, just as Upsala did when Linné died.

While here at Neuchâtel, pushing along the work on the fishes of central Europe, the fossil fishes, and the fossil echinoderms of the Jura, he became interested in the glaciers. To others we owe the discovery that glaciers move, and that in former times they covered more of Switzerland than they do to-day. At first Agassiz had little sympathy with such ideas, but as he studied the phenomena in the valley of the Rhone he was converted to the new views, and soon became the foremost authority in all that pertains to glaciers. Even were we to allow to Forbes and Schimper all that they claim, still it would be to Agassiz that we owe the systematization of the facts and the acceptance of the principles involved by the scientific world. As the work left Agassiz's hands it was about as complete as it could be without a knowledge of physical methods and phenomena such as Agassiz never claimed to have. Later Tyndall built upon Agassiz's foundation the glacial theory of to-day, rounding it out on the physical side and making it complete.

Each summer during these glacial studies was spent upon some of the glaciers of the Alps, where regular investigations of the most elaborate kind were carried on with the best of instruments, the Glacier of the Aar being the one the most thoroughly investigated. During the rest of the year Agassiz

worked at Neuchâtel, teaching his classes, directing his assistants, artists, etc., and working away at his various books, of which he had now in hand, besides those already mentioned, one upon fossil molluscs and one — the *Nomenclator Zoologicus* — the compilation of which must have been about as tedious a bit of work as one could easily imagine, but a work indispensable to the systematic zoologist of to-day. His work on fossil fishes had extended his reputation, and the treasures in the collections of several wealthy patrons of science in England were poured in to be worked over and incorporated in the series of volumes on these forms.

So from the scientific standpoint, affairs were most prosperous during these years at Neuchâtel, but financially they were far less rosy. Agassiz was not a business man, and his publications and his lithographic establishment were a terrible load. Books upon subjects of pure science never have paid their expenses, and the prospect is that they never will. So all the bills for artists, assistants, lithographers, and printers had to be paid from the small income of a professor in a provincial academy. At last the limit was reached and the lithographic establishment had to be sold.

At this time of financial distress Agassiz received, through the good services of Lyell, the geologist, an invitation to deliver a course of lectures before that unique institution, the Lowell Institute in Boston. Here was a chance to see the New World, and the opportunity was the more eagerly seized since the king of Prussia (Neuchâtel was then a part of the Prussian domain) gave Agassiz \$3000 to aid him in his American explorations. Leave of absence was obtained from the academy at Neuchâtel and in 1846 Agassiz left for America, never to return to his Swiss home except as a visitor for a few months.

Boston received the newcomer with the greatest cordiality, and a little later Philadelphia and Charleston were scarcely behind in the warmth of their welcome. He hired a house in East Boston, and this soon became almost a repetition of the old home at Neuchâtel. Together with Agassiz, or following close upon his heels, came one after another of the old Swiss

friends and assistants,—Desor, Guyot, Marcou, Pourtalés, Girard, Richard, Sonrel, Burckhardt, and others,—so that it may be said that the work was merely transferred from the Old World to the New, the personnel of the establishment being much the same, but the work was changed in character.

In 1847 came the appointment to the Chair of Zoology and Geology in the newly established Lawrence Scientific School of Harvard College, and in the winter of 1848 Agassiz began his work as an instructor in the New World,—work which continued until his death, even the invitation to return to Paris as the head of the museum there being insufficient to call him back to Europe.

With this change from the Old World to the New, the work of Agassiz changed. It was not only that there was a change in the fauna: there was also a change in the man. In Europe his work had been largely systematic, although all of his papers had a strong substructure of anatomy. In America, surrounded as he was by a wealth of new and undescribed forms, one might have expected him to have become more purely a systematist than ever before. He became rather what to-day we would call a morphologist, and it is noticeable that in the majority of the papers he published in America, the structural or developmental side of the subject is the more prominent, the descriptions of new species occupying a subsidiary position.

Domiciled at Cambridge, Agassiz began collecting as never before. From all parts of the country specimens were obtained, but the only place for storage of them was a barn-like structure near the banks of the Charles. His trips to Charleston, where he early received an appointment in the medical school, enabled him to make collections in the semitropical waters there, while a trip to Lake Superior in 1848 resulted in large fresh-water collections. Besides, he arranged for exchanges of specimens with the museums of Europe and this country, and soon a larger building, a two-storied structure, long known as Zoological Hall, became the home of the specimens. This, however, was not safe from fire. It was built of wood, and, besides, a great part of the collections were preserved in alcohol, even more inflammable than the building itself. But where the

money to build according to his desires was to be obtained was for a long time a serious problem.

In 1858 Mr. Francis C. Gray left in the hands of trustees a bequest of \$50,000 to establish a museum of comparative zoology. This fund was passed over into the control of Harvard College; friends raised by subscription over \$70,000, while Agassiz labored with the Massachusetts legislature to such good effect that the Commonwealth appropriated \$100,000 to properly house the collections. To the Museum of Comparative Zoology thus established — the Agassiz Museum as it is familiarly known in Cambridge to this time — Agassiz gave his private collections which had cost him in pecuniary outlay about \$10,000.

The building then planned was to form three sides of a hollow square, the front to be 364 feet long and 64 feet wide, the two wings to be 205 feet long and as wide as the front. The part at first erected was but about two-fifths of one of the wings, and this portion, sufficient for all immediate needs, was formerly opened as a museum in November, 1860. To-day the whole of one wing is completed, about four-fifths of the front is occupied, while two-fifths of the other wing is built. There has been, however, a change in the plans in this respect. The museum is not purely zoological in character, but it contains as well the laboratories and collections of geology, mineralogy, and a large part of the botanical laboratories and collections (except the phanerogamic herbarium, kept at the Botanic Garden); while the Peabody Museum of American Archæology and Ethnology occupies the incomplete wing. Corresponding to this change, the whole structure is now known as the University Museums, the Museum of Comparative Zoology occupying the basement and five floors of one of the wings and a part of the front, with a total floor area of nearly three acres.

During his American life Agassiz made several extended scientific trips. In 1851 he went to Florida under the auspices of the United States Coast Survey; in 1865-66 he spent, with a party of friends, assistants, and pupils, ten months in Brazil, collecting chiefly in the valleys of the Amazon and Rio Negro, bringing back with him enormous collections to add to those

already at Cambridge. In 1871, again enjoying the hospitality of the Coast Survey, he sailed from Boston in the steamer "Hasler," passed through the Strait of Magellan, up along the west coast of South America and the Galapagos Archipelago, and finally reached San Francisco. This last trip was in many ways a disappointment, for the steamer itself was in poor condition and its equipment inadequate for deep sea dredging. Yet the collections made were very considerable.

But we must return to Agassiz's work at Cambridge, and especially to his work as a teacher. As time passed most of those who came with him from Europe either returned or obtained occupation elsewhere; but their places were taken by American students who were attracted to Cambridge by his name. It may be said that no teacher in recent years, unless it be the venerable Leuckart at Leipzig, has trained so many students who later arose to prominence in scientific lines as did Agassiz. The following names occur to us at the moment of writing—a little research would doubtless add to the number: J. G. Anthony, Alexander Agassiz, J. A. Allen, J. M. Barnard, Albert Bickmore, W. K. Brooks, Waldo I. Burnett, Caleb Cooke, Henry James Clarke, Thomas Clarke, William H. Dall, Walter Faxon, Jesse W. Fewkes, Samuel Garman, Charles Hamlin, Frederick C. Hartt, Alpheus Hyatt, William James, David S. Jordan, John L. Le Conte, Theodore Lyman, Horace Mann, James E. Mills, Charles S. Minot, Edward S. Morse, John Macready, William H. Niles, Albert S. Ordway, Alpheus S. Packard, John B. Perry, Frederick W. Putnam, Nathaniel S. Shaler, Samuel H. Scudder, William Stimpson, Sanborn Tenney, Philip R. Uhler, Addison E. Verrill, Burt G. Wilder, and Charles O. Whitman. When we look over the names of those who are doing the zoological work of America to-day, we find few who have not been trained by Agassiz, by his pupils, or by his pupils' pupils.

Agassiz's method of teaching was largely the laboratory method which we know to-day. Mr. Scudder has so well described his experience when he first went to study entomology with Agassiz that we cannot refrain from quoting from his account :

"When do you wish to begin?" he asked.

"Now," I replied.

This seemed to please him, and, with an energetic "very well," he reached from a shelf a huge jar of specimens in yellow alcohol.

"Take this fish," said he, "and look at it; we call it a *Hæmulon*. By and by I will ask you what you have seen."

With that he left me, but in a moment returned with explicit instructions as to the care of the object intrusted to me. "No man is fit to be a naturalist," said he, "who does not know how to take care of specimens." . . . Entomology was a cleaner science than ichthyology, but the example of the professor, who had unhesitatingly plunged to the bottom of the jar to produce the fish, was infectious; and though this alcohol had a very ancient and fish-like smell, I really dared not show any aversion within these sacred precincts, and treated the alcohol as though it were pure water. . . . In ten minutes I had seen all that could be seen in that fish. . . . Half an hour passed, an hour, another hour; the fish began to look loathsome. I turned it over and around; looked it in the face—ghastly! From behind, beneath, above, sideways, at a three-quarters view—just as ghastly! I was in despair. At an early hour I concluded that lunch was necessary; so, with infinite relief, the fish was carefully replaced in the jar, and for an hour I was free. . . .

Slowly I drew forth that hideous fish, and, with a feeling of desperation, again looked at it. I might not use a magnifying glass; instruments of all kinds were interdicted. My two hands, my two eyes, and the fish,—it seemed a most limited field. . . . At last a happy thought struck me,—I would draw the fish; and now, with surprise, I began to discover new features in the creature. Just then the professor returned.

"That is right," said he; "a pencil is one of the best eyes. I am glad to notice, too, that you keep your specimen wet and your bottle corked." With these encouraging words, he added: "Well, what is it like?"

He listened attentively to my brief rehearsal of the structure of parts whose names were still unknown to me. . . . When I had finished, he waited, as if expecting more, and then, with an air of disappointment, "You have not looked very carefully. Why," he continued most earnestly, "you have n't even seen one of the most conspicuous features of the animal, which is as plainly before your eyes as the fish itself. Look again! look again!" and he left me to my misery.

I was piqued; I was mortified. Still more of that wretched fish! But now I set myself to my task with a will, and discovered one new thing after another, until I saw how just the professor's criticism had been. The afternoon passed quickly, and when toward its close the professor inquired, "Do you see it yet?"

"No," I replied, "I am certain I do not; but I see how little I saw before."

"That is next best," said he earnestly; "but I won't hear you now. Put

away your fish and go home; perhaps you will be ready with a better answer in the morning. I will examine you before you look at the fish."

This was disconcerting. Not only must I think of my fish all night, studying, without the object before me, what this unknown but most visible feature might be, but also, without reviewing my new discoveries, I must give an exact account of them the next day. . . .

The cordial greeting from the professor the next morning was reassuring. Here was a man who seemed to be quite as anxious as I that I should see for myself what he saw.

"Do you, perhaps, mean," I asked, "that the fish has symmetrical sides with paired organs?"

His thoroughly pleased "Of course, of course!" repaid the wakeful hours of the previous night. After he had discoursed most happily and enthusiastically — as he always did — upon the importance of this point, I ventured to ask what I should do next.

"Oh, look at your fish!" he said, and left me again to my own devices. In a little more than an hour he returned, and heard my new catalogue.

"That is good, that is good," he repeated; "but that is not all; go on." And so for three long days he placed that fish before my eyes, forbidding me to look at anything else or to use any artificial aid. "Look! look! look!" was his repeated injunction.

This was the best entomological lesson I ever had, — a lesson whose influence has extended to the details of every subsequent study; a legacy that the professor has left to me, as he left it to many others, of inestimable value, which we could not buy, with which we cannot part.

Agassiz did a great work by his teaching, but he reached a wider circle by his popular lectures delivered before lyceums, teachers' associations, and farmers' institutes, as well as by his writings. Considering the time of its publication, no better text-book has ever appeared than the *Principles of Zoology* by Agassiz and Gould, first issued in 1848. Of this work, which bears the impress of Agassiz on every page, only the first part was ever published, but this part has passed through many editions and has a sale even to-day. The second part was prepared by Dr. Gould; the manuscript was written out, many of the engravings made, but Agassiz never found time to revise it as he wished. Other popular works which extended the influence of Agassiz far and wide were his *Methods of Study in Natural History*, first published in the *Atlantic Monthly*, and his two series of *Geological Sketches*, most of which first appeared in the same periodical.

In his more strictly scientific publications Agassiz employed the same sumptuous mechanical dress for his thoughts here as he did in Europe, and his *Contributions to the Natural History of the United States* is, even at this day, but rarely surpassed in beauty of presswork and quality of illustration. This work was to have been issued in ten quarto volumes, and the subscription list obtained (over 2500) before the first volume was issued is an index of the popular esteem in which the professor was held. Only four volumes were published and then the series stopped. Doubtless many of the subscribers expected gaily colored plates of birds and fishes and shells, such as were to be found in the then recently issued *Natural History of the State of New York*, and possibly some of them expected popular disquisitions on animals and plants something after the same style as was later furnished by the garrulous Rev. J. G. Wood. They received nothing of the sort. These four volumes were filled with an elaborate essay on the principles of zoological classification, a minute account of the development of the turtle, and details of the anatomy and histology of the Cœlenterata. The result was that the subscribers fell off. Agassiz, too, had so much other work to do that the series was never completed.

These same volumes, however, possessed great scientific value, and the *Essay on Classification* should be read by all, for nowhere will one find a clearer statement of the teleological argument, nowhere a better survey of the various systems of classification proposed at different times by the older masters. The work on the turtles is referred to elsewhere in this journal, but the studies upon the cœlenterates must not be ignored. This work marked a new departure in Agassiz's work. In Europe, removed as he was from the sea, he had no chance to study these forms, but at East Boston, at Charleston, and at his summer residence at Nahant this new world was opened up to him. So in the two volumes of the *Contributions* which deal with the cœlenterates we have a most valuable contribution to our knowledge of these forms. Here we find the demonstration that the millipores belong to the Hydrozoa rather than to the Scyphozoa. Here we find accounts of the life histories

of many of our hydroids; here details of the histology of these interesting forms. It is true that we can no longer agree with some of his theses. We no longer accept his views as to the homologies of the Radiata, nor can we longer adopt the Radiate group; but these changes, due to our increase of knowledge, detract but little from the general value of the work.

These volumes form the only extensive work published by Agassiz during his residence in America, but his shorter papers are both numerous and valuable.¹ He planned numerous other works, but none of these plans were carried out. The labor of teaching and the work demanded by a great and rapidly growing museum so completely occupied his time that there was no chance to carry out these contemplated investigations.

Three times was Agassiz recalled to Europe: in 1855 to the chair of zoology in the newly established University of Zurich, in 1857 to the head of the Jardin des Plantes in Paris, and in 1859 again to the same position. In spite of all of the attractions of these positions, he decided to remain in America, and at the beginning of our Civil War he showed his faith in the United States by becoming a naturalized citizen,—an American by right as well as by residence.

During the latter years of his life his originally strong constitution began to show the effects of early exposure and of overwork. Several times he had to give up entirely and to rest, but any long rest was impossible for him. In 1873 came the chance to establish a summer school for teachers, and the labors connected with the short-lived but ever-memorable school at Penikese told severely upon him. Still he kept at work, and even as late as the 2d of December he delivered a lecture before a farmers' institute at Fitchburg, his last public appearance. December 6 he was taken with paralysis of the larynx, and on Dec. 14, 1873, death came. Agassiz is buried at Mt. Auburn, and his monument is an Alpine boulder from the Glacier of the Aar, while around it grow pines transplanted from the hill behind Neuchâtel.

¹ A practically complete bibliography is given in Marcou's *Life of Agassiz*. It enumerates 425 titles.